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A VELVET-ROLL SEPARATOR FOR SEED TESTING 1/

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The conventional velvet roll separator is widely used on farms and in commercial plants for cleaning seed. It is often referred to as a "Dodder Mill" because it was designed originally to remove this noxious weed seed from clovers. The machine will remove rough-surfaced seed or irregular-shaped material from various kinds of smooth seed. Typical separations are dodder from alfalfa, cutleaf cranesbill from crimson clover, timothy from alsike clover, broken seed from whole seed, dirt clods from beans, peas from vetch, and unhulled from hulled lespedeza. Other rough weed seeds that can be removed from planting seed include dock, wild carrot, sorrel, peppergrass, foxtail, catchfly, and oxeye daisy.

The velvet covered rolls of the dodder mill are arranged in pairs and mounted with one end of the pair higher than the other. The rolls in each pair are in contact with each other for their full length and are driven in opposite directions. If more than one pair is used, they are mounted in the machine one above the other in parallel plans. The mixture of seed to be separated is introduced to the upper ends of each pair of rollers. The velvet on the rollers catch and throw out rough surface material as the mixture moves by gravity down the trough or groves formed by the revolving rollers.

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Results of laboratory tests with commercial seed cleaners show that the velvet roll machine is more precise in making separation on the basis of shape and surface texture of seed than most other machines. However, the effectiveness of the cleaner depends to a large extent upon (1) roll speed, (2) rate of feed, (3) clearance between the rolls and shields, and (4) the angle of incline of the rolls. A laboratory scale machine was constructed and thoroughly tested (see Appendix figures 5-9).

TEST RESULTS

Roll Speed. In general, higher roll speeds tend to remove more material. If too many smooth seeds are thrown out with the rough seed, the roll speed should be reduced. If too many rough seeds are left in with the clean seed, the roll speed should be increased.

Figure 1 shows the results of tests investigating the effect of roll speed in removing dodder from red clover. At 70 r.p.m. about 7-1/2 percent of the dodder remained with the clover, but as roll speed increased, the dodder remaining in the mixture decreased to less than one-half percent at 260 r.p.m.

Feed Rate. The rate at which seed is fed into the rolls is important because each seed must come in contact with the velvet roll before the rough seeds can be bounced out of the mixture. Over-feeding will cause flooding of the rolls and reduce the percentage of rough seed removed.

Shield Clearance. The height of the shield above the velvet roll also influences the separation and should be adjusted according to seed size. A rule of thumb method is to provide a clearance equal to one and one-half times the diameter of the seed being run. However, this adjustment is not critical providing the seed has room to leave the roller after contact, strike the shield, and be reflected back to the roller. This "ricochet" action continues until the rough seeds are bounced or walked over the top of the rollers and out of the mixture. If clearance is too great, the rough seeds fail to contact the shield, and repeatedly fall back into the seed being cleaned. If the clearance is too small, both the smooth and rough seed will be pressed into the velvet fabric and carried around the roller like a ball-bearing in a race, and then drop into the reject fraction.

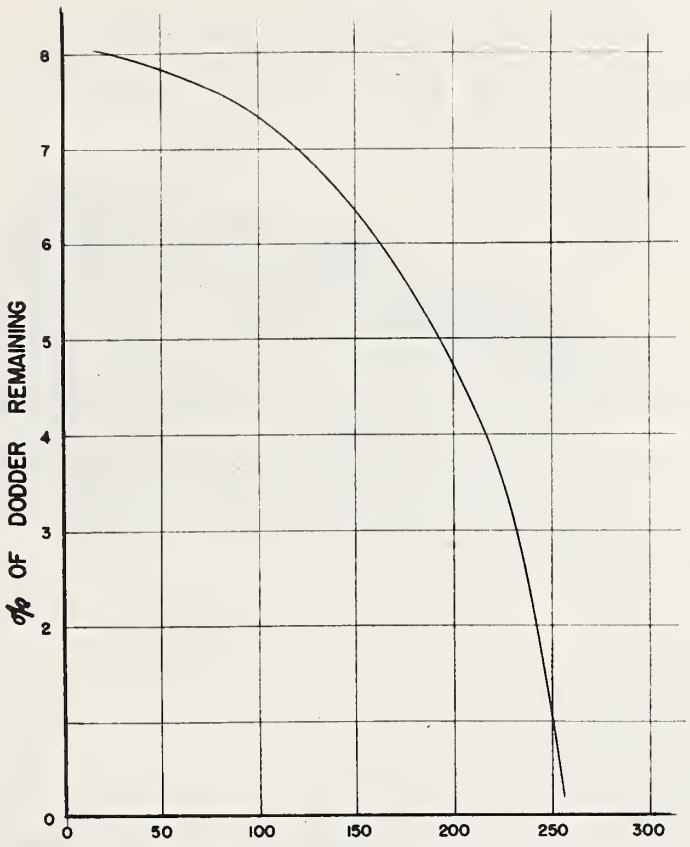


Figure 1. Relation of dodder removed to roll speed.

Angle of Incline. The roll angle inclination over the range of adjustment (7° to 22°) does not significantly change the percentage of rough material removed. However, the steeper the angle, the faster the seed will travel from feed end to discharge end of the machine. Therefore, capacity and length of exposure of seed to the rolls can be varied somewhat by increasing or decreasing the angle of inclination.

SERVICE REQUIREMENT

It was recognized that the selective separating action of the velvet roll machine could be used to advantage in mechanizing portions of seed purity determinations. However, use of the conventional machine was prohibited in the careful analytical procedures of the seed testing laboratory by such limitations as seed contamination possibilities, difficult inspecting and cleaning, roll speed fluctuations, non-constant feeding, and other lack of flexibility in operation.

The conversion, described here, of the portable, hand-operated unit was undertaken to eliminate the shortcomings of the conventional velvet roll machine and to develop an efficient, precision-type separator specifically for laboratory use. (Fig. 2.) The completed revision is shown in Figure 3.

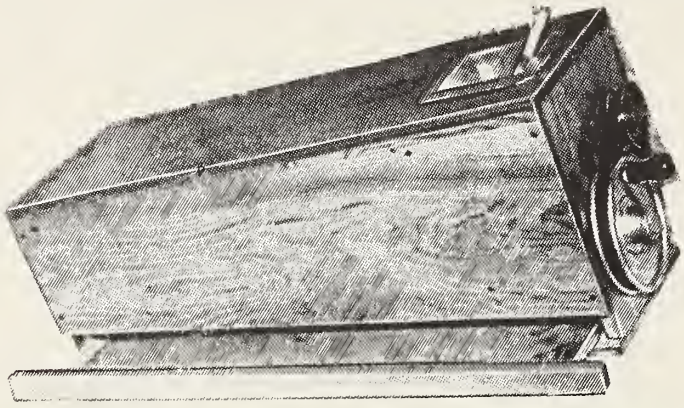


Figure 2. Portable, hand-operated velvet roll.

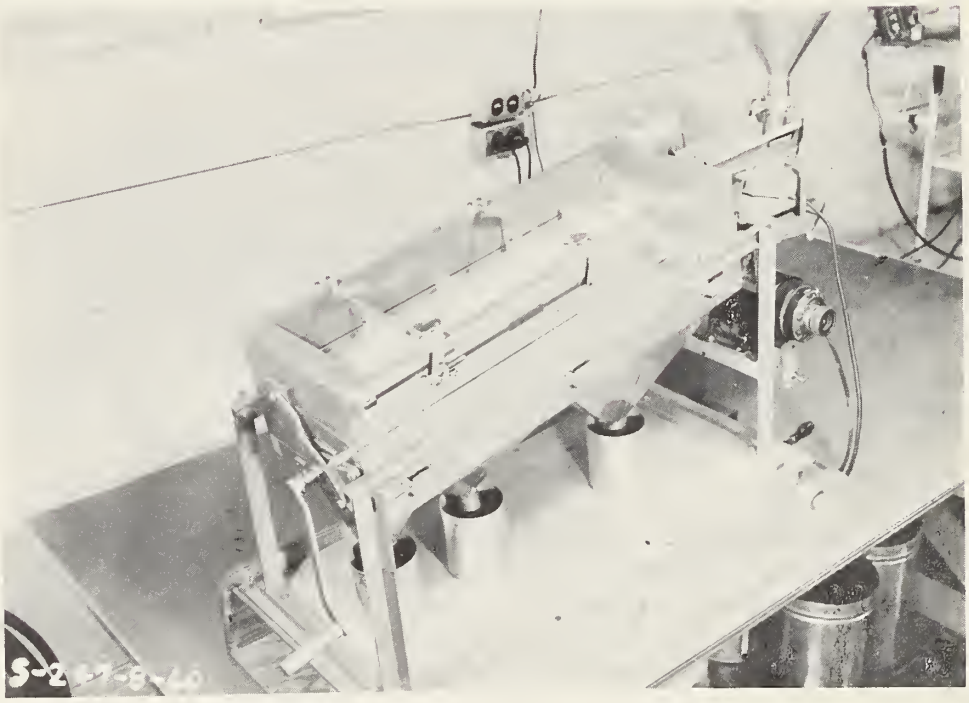


Figure 3. Rebuilt, motorized velvet roll (closed for operation).

The machine has several unique features:

1. It is divided into three horizontal sections mechanically linked so that a single lever simultaneously lifts the roll shield and drops the discharge chutes for easy inspection and cleaning. See Figure 4. The discharge chute section is held firmly in place by magnetic latches, when the machine is operating, but can be dropped readily by enough lever pressure to overcome the magnetic attraction of the latches.

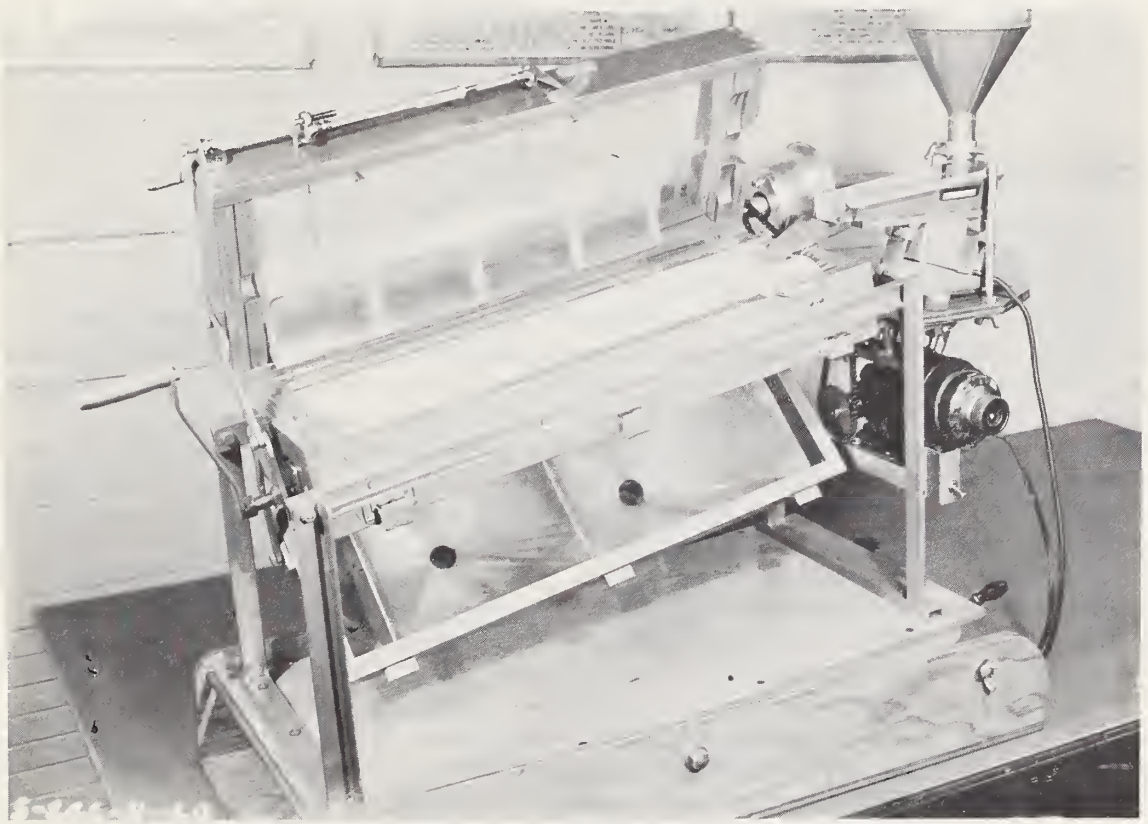


Figure 4. Rebuilt, motorized velvet roll (open for inspection and cleaning).

2. The plastic shield over the rolls is supported by overhead linkage so that its clearance can be quickly and accurately adjusted by means of a crank, and registered on an indicator comprised of a pointer and scale.

3. A variable-speed motor with a speedometer is used to adjust the roll speed from 25 to 300 r.p.m.

4. A vibratory feeder accurately controls feed rate from a few seed per second up to the capacity of the separator.

5. An adjustable base and crank screw permit variation of the roll incline from 7^{o} to 22^{o}, and the angle can be read from an attached indicator.

CONSTRUCTION DETAILS

The motorized laboratory seed separator was constructed using the rolls from a Warsco portable sample mill. The wooden frame of the mill was dismantled, salvaging only the end pieces (3/4 inch thick) which support the roll bearings. As shown on Appendix fig. 9, a wooden box was built using the salvaged end pieces and 3/4-inch stock. An identical end piece was fastened to the discharge end piece with six No. 8 FH wood screws 1-1/4 inches long. A vertical section one inch wide was cut out of the inner discharge end piece forming a discharge chute for clean seed. Outside dimensions of the box are 3-1/8 inches high, 9 inches wide, and 24-1/4 inches long. The length is only approximate; the exact length is governed by the length of the rolls plus a minimum end clearance. The sides of the main box are attached to the bearing support end pieces with No. 8 FH wood screws, 1-3/4 inches long. No glue is used, so servicing of the rolls is possible should this be necessary.

The wood frame for the lower hinged section is of the same outer dimensions as the main frame and is also of 3/4-inch stock, one inch wide. It can be glued and screwed at the corners. The sheet metal chutes for the three seed fractions are attached to this frame with tacks or screws. Care should be taken to keep inside surfaces and corners as smooth as possible in order to simplify cleaning and to prevent contamination between seed lots.

The adjustable plastic shield covering the rolls is housed in the upper hinged section. Outer dimensions of this part correspond to the main frame except for the height which is 2-1/2 inches. The discharge end piece is double thickness to correspond with the main frame. The feed end piece is also double thickness with the inner 3/4-inch piece cut out to make a close fit with the gears attached to the rolls at the feed end. This piece also must have a slot cut in its lower edge to make room for the tapered sheet metal feeding trough which is attached to the main frame with two small screws.

The metal shield in the original machine can be used with slight modification at the ends to fit the upper hinged section. The mechanism for raising and lowering the shield is attached to the front of the upper section. (See Appendix fig. 7). Small pieces of sheet metal should be soldered to the metal shield to receive the raising--lowering arms that adjust the clearance above the roll.

The three sections of the wood frame are hinged together on the back side. Four butt hinges are used, two above and two below.

The opening mechanism shown on Appendix fig. 6 is mounted on the lower discharge end of the machine. Its design allows the bottom frame to counterbalance the top frame so that, when opened, the machine will remain in that position without being held. An outer-center locking device and three magnetic latches hold the machine closed.

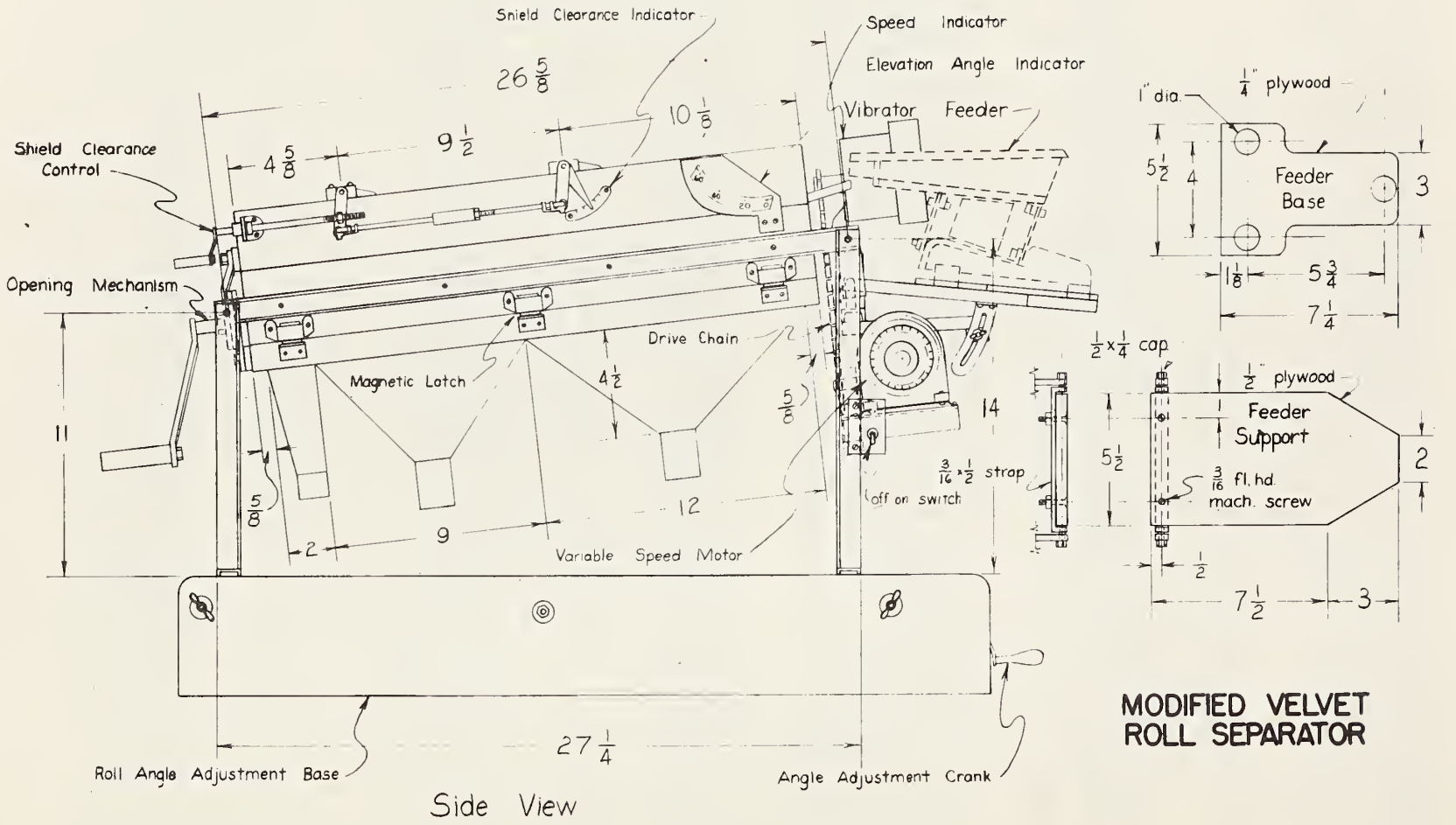
The supporting frame is constructed from one inch channel and one inch angle iron. The channel rails along the sides of the main wood frame are mounted with round head wood screws. See Appendix fig. 5. The supporting frame is welded. The feeder mounting bracket is bolted to an extension of the box side rails. The feeder support is mounted with one end hinged so that the angle of the feeder can be adjusted as the inclination of the rolls is changed. Exact dimensions for the feeder support will depend on the feeder used.

The drive motor is mounted on angle iron welded between the vertical supports. Position is shown on Appendix fig. 5. Exact dimensions and shape of the mounting support again depend on the type of motor used. A variable speed motor is used so that roll speed can be varied from 25 to 300 r.p.m.

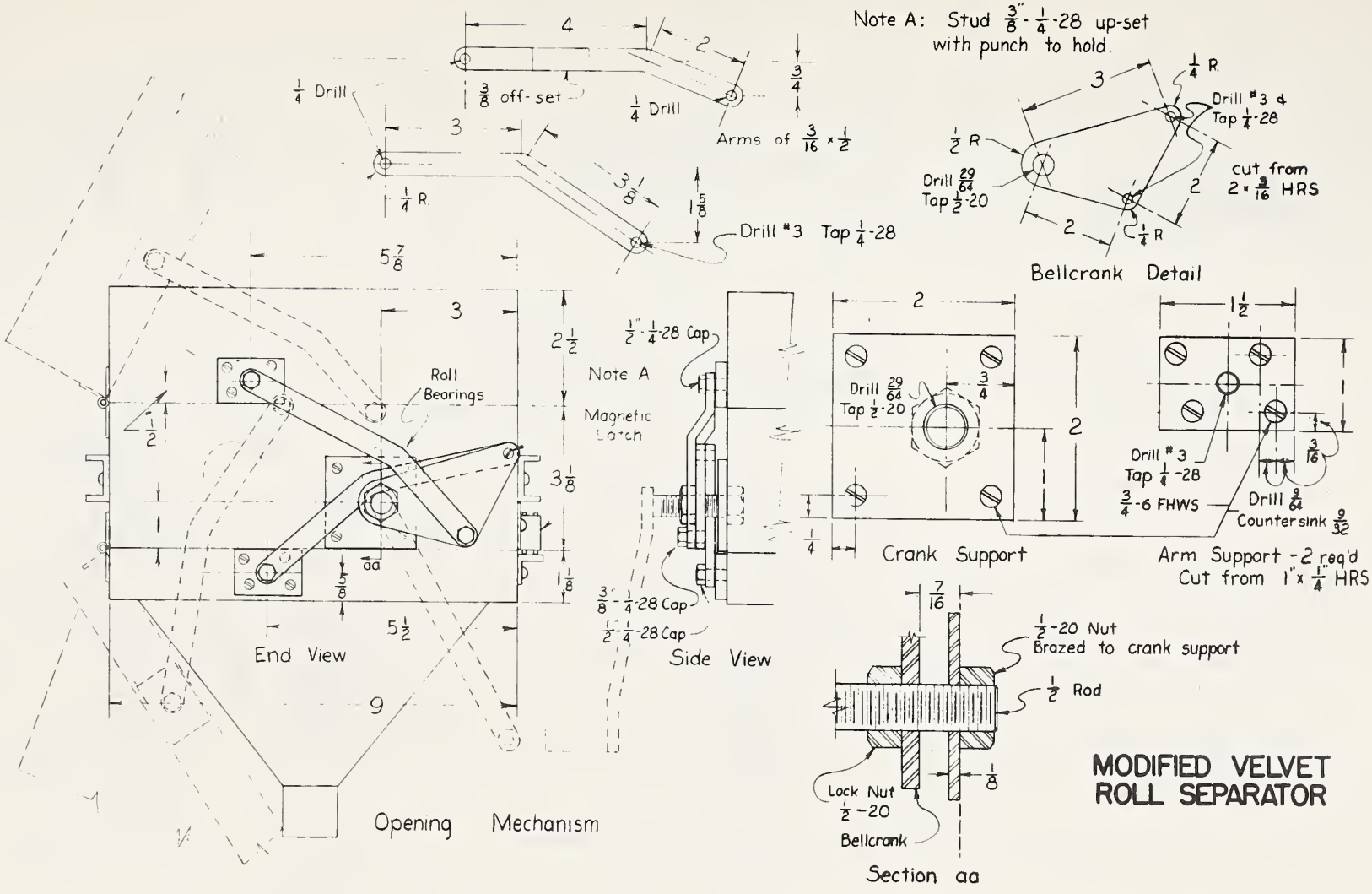
An adjustable base is used to change the angle of the rolls. Shown on Appendix fig. 8. The supporting platform pivots on a shaft through the center part of the base. Shafts at either end, with wing nuts for tightening, clamp the base in position when the desired inclination angle is reached. A screw with a bell crank mechanism and arms provides the lift to change the angle of the base. Details of this mechanism are shown on fig. 8 of the drawings. Elevation angle of the rolls is given by a gravity-operated angle indicator.

An automobile speedometer was calibrated and a new dial was prepared to read the r.p.m. of the rolls directly. It is mounted on the feed end of the frame, and its drive is on the roll opposite from the motor-driven roll.

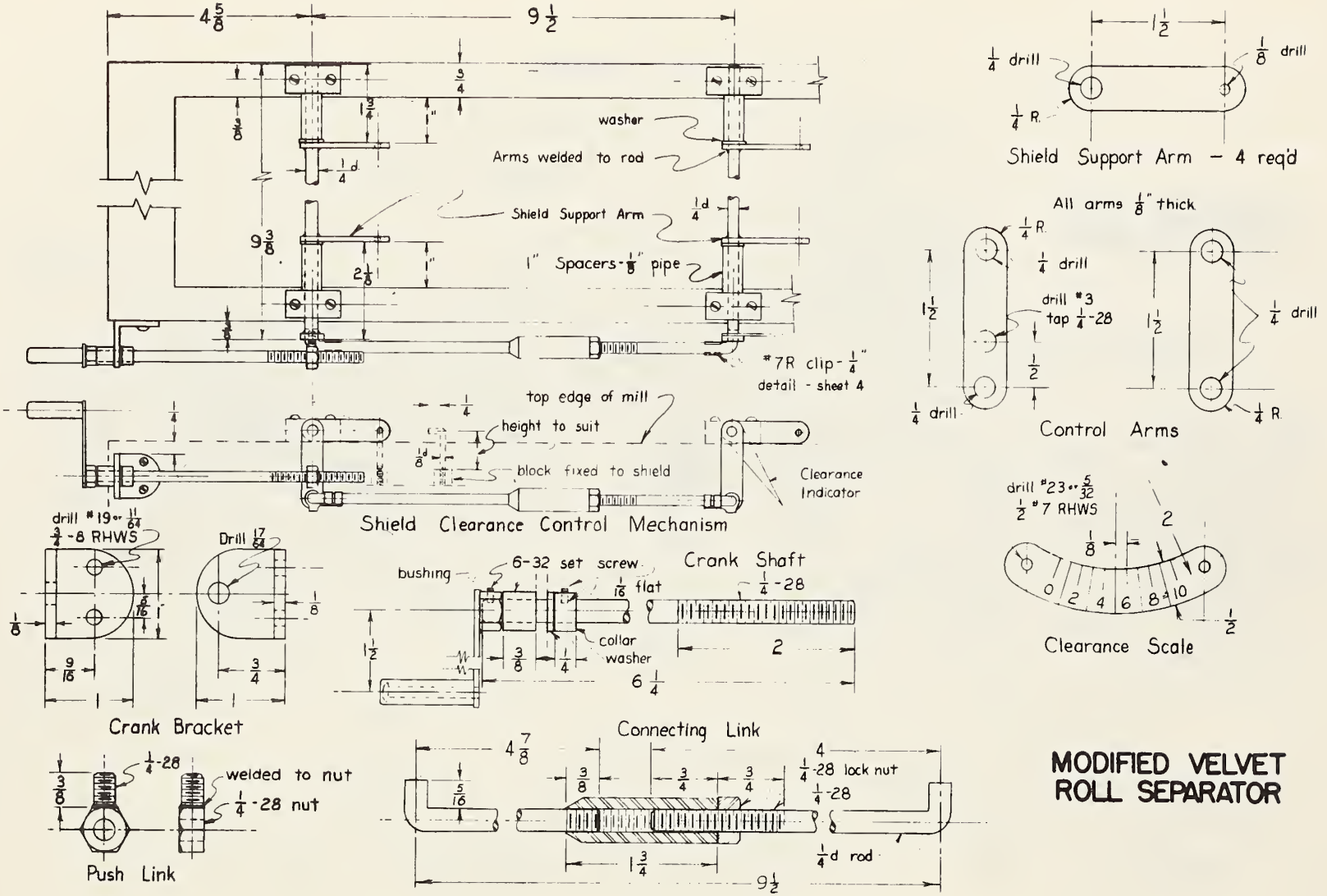
With the above information, drawings, and photographs, a testing laboratory should not find it difficult to have a velvet-roll separator converted for precision use.



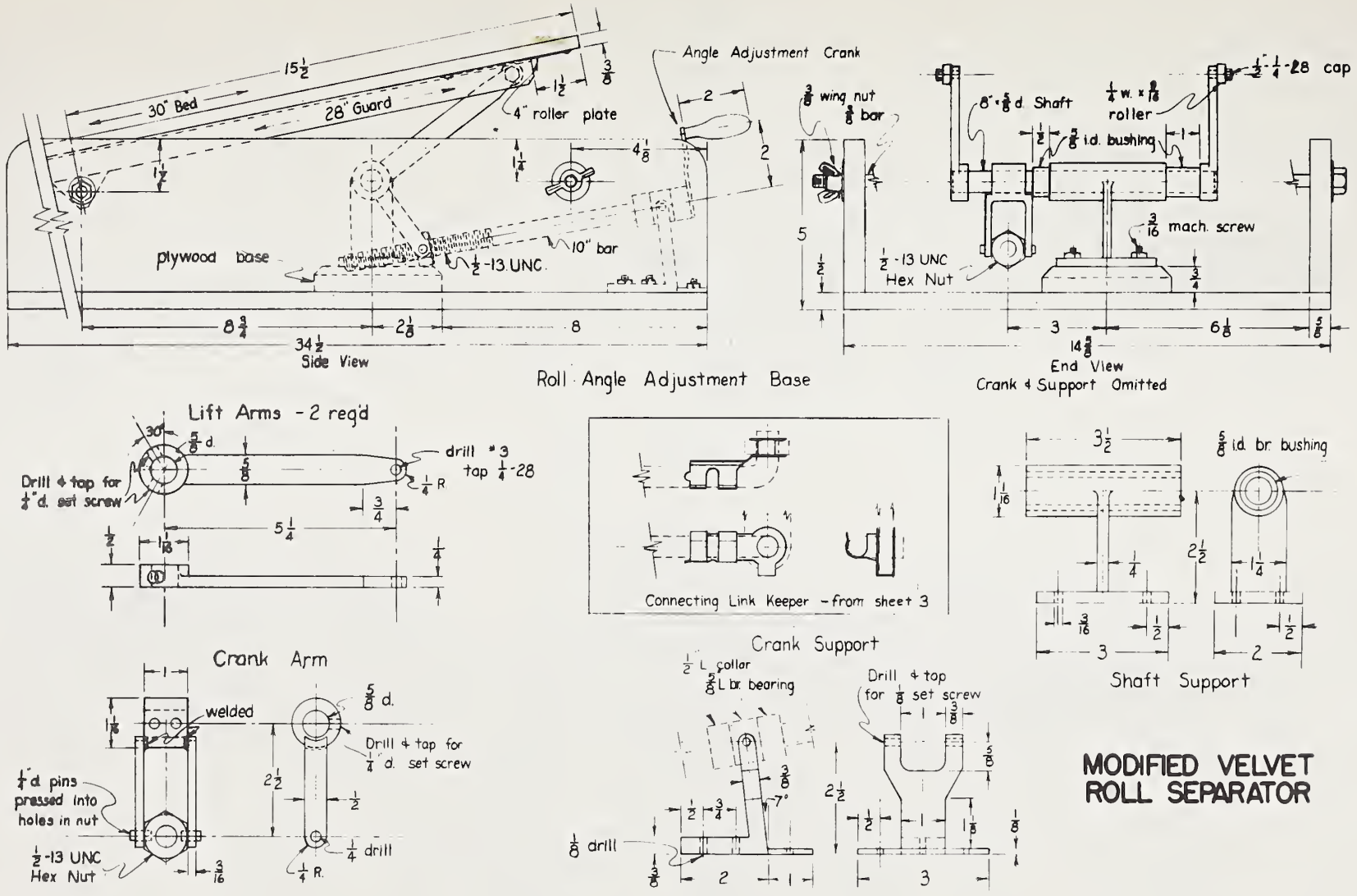
Appendix Figure 5.



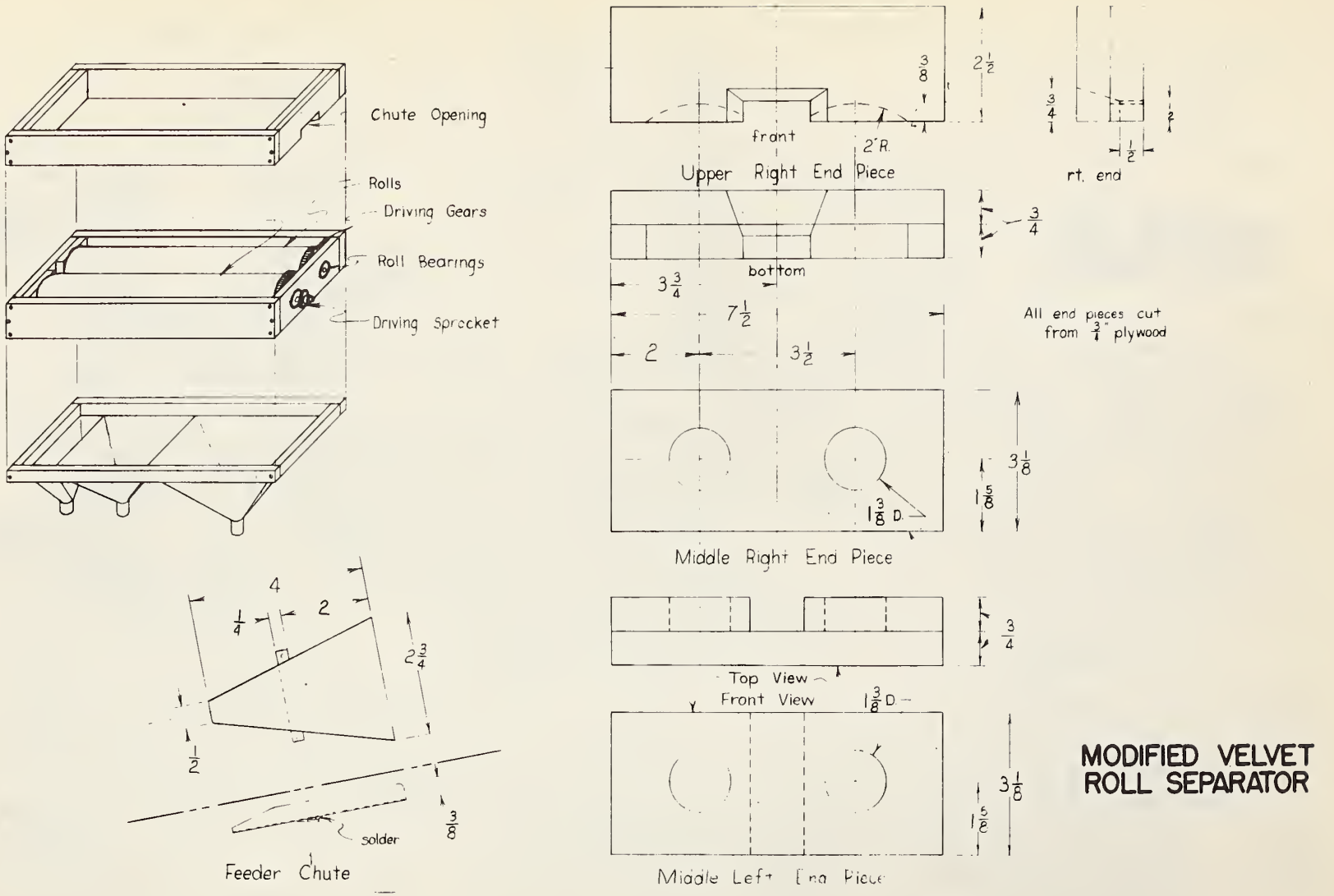
Appendix Figure 6.



Appendix Figure 7.



Appendix Figure 8.



Appendix Figure 9.